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## Investigating effective waterproofing materials in preventing roof leaking; initial comparative study: Malaysia, U.K.

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### Abstract

This paper focuses on the waterproofing materials used for real project samples involving real problem mainly with roof related leakage mostly happened in Malaysia and some cases in the United Kingdom. The study outlines typical problem facing with the building leakage within the humid warm tropical climate as well as highlighting some obvious leakage scenario found within the opposite four season's climate in the UK. It also tabling the list of practical waterproofing solution done for each of the seepage problem from the real life case studies highlighting the technique and suitable best materials and products used. The paper target to help the construction players i.e. the maintenance team, building owner as well as the designer to identify the correct steps especially when choosing the right waterproofing materials in dealing with the building's rectification work typically dealing with the building leakage syndrome problem.

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### 1. Introduction and background

Talib and Sulieman stressed waterproofing is extremely important to the humid tropical climate region like Malaysia and the selection of the waterproofing material can be based on the level of material exposure to the rainwater [1]. According to the Malaysian Government 2014 Budget allocation presented by the Prime Minister of Malaysia, Dato Seri Mohd Najib Tun Razak, the Malaysian Government had allocated some 4 Billion Ringgit to initiate private developer to build more houses on their high impact projects to ease-up affordable public housing problem. At the same time, the Government had allocated from the budget 100 Million Ringgit for the maintenance budget given to one of the Ministry to maintain the ministry buildings as well as 82 Million Ringgit to refurbish

unfinished housing project for about 8,200 houses. Some of the maintenance works mentioned by the Prime Minister is like doing repainting of the houses as well as doing the lift maintenance for the flat and apartment building. It is interesting to note that from the previous Government budget in 2012 and 2013, the Government had allocated 1 Billion Ringgit only for the maintenance and classroom addition of the public schools in Malaysia and allocated another 450 Million Ringgit in 2014 budget for the maintenance and upgrading the interior for the same school buildings.

Findings from MORI (Marketing and Opinion Research Institute) pool; a leading marketing research company in the UK mentioned that despite the small proportion of UK household income spent on housing repairs and maintenance, most people (89%) agree that regular work is needed to help maintaining the value of the properties. Most UK homeowners agree that repairs and maintenance are important, and this is reflected in the high proportion who have had work carried out in the last 5 years.

For convenience, the readers can do the cross reference on all the Malaysia and UK building leakage cases detail at <https://usm.academia.edu/RoslanTalib> tabling information like failure causes as well as possible best solution suggestion. Kindly refer to the Malaysia (real projects) building leakage case studies/defects schedule file 1, 2 and 3 974 case studies) as well as for the UK cases refer file 1 and 2 for building leakage syndrome titles (35 case studies).

### *1.1. Research Objectives and Methodologies*

The objective of this research paper is to identify the best method and the best waterproofing system and material used to solve that lead to the building leakage that happened to the regular buildings focusing especially for the Malaysia cases as well as for the United Kingdom. Among the objectives is to identify the best method used to solve the leakage which is the most important for any waterproofing rectification works. In this paper, the suggestion for the reader to use the right waterproofing material for the right task may save more money if the material being choose with the right one. As we are aware most of the building defects that start-up with the water seepage mainly form the rain water, ground water or from the piping or water tank leakage. Finding the source of the leakage and then to suggest the type of waterproofing material used for the rectification works as well as for the new building works are very important to the building owner. Somehow, the research intention is to identify the most occurred leakage so that the solution method can be recommended to ensure the problem will not repeated. At the same time, the objective is to identify typical defects that always cause the water seepage into the interior of the building thus making problem to the occupier as well as its internal valuables. To improve the data quality, only the case studies that can contribute to establish the method to prevent roof leaking are being considered.

### *1.2 Data Collection Methodology*

The selected Malaysian cases studies data are based on the collection of real rectification works on building leakage projects. The reparative tasks were done by the local waterproofing contractor implemented mostly at the cities located within the western part of Malaysia's Malay peninsula; cities like Kuala Lumpur, Petaling Jaya, Melaka, Ipoh and Penang. A total of 74 real project case studies has been identified and selected, accumulated since 1994 including buildings that can be categorized as historical or heritage buildings. In the process accumulating the data, a series of interview were made with the building owner, building maintenance representative and of course the reparative contractor. It is quite interesting to note that all the Malaysian cases are the real maintenance rectification works and has been given 10 years warranty for the said work. Thus the standard of work must be in performed within the highest quality and using the best product quality for each job. Other than that, the redo waterproofing work must be done within the budget to make business profit thus the detail rectification works step must be done at the best.

As for the UK data collection, a personal observation has been done by the author mostly in Birmingham, England where the author reside briefly as well as attending the site in person at cities like Blackpool, Liverpool and Newcastle. In some cases, the author had opportunity to discuss personally the leakage problem with building's maintenance officer and building owner for the UK case studies. A total of 35 case studies had been identified for

the UK side regarding to the building roof related leak for this study. The idea having the different climate situation compared to the hot humid equatorial weather is to compare on the leakage scenario happened based on different construction method and to enrich the paper scope. From the 35 cases, there are 11 cases that can be considered as heritage buildings compare to 2 cases for the Malaysian one.






From the each number of the cases, the author sorting it out in identifying what are the typical factors on why the building leakage is happening and at the same time listed out the best possible practical solution done using the right waterproofing materials.



### 1.2.1 Strategies Grouping Identification

To ease-up reader for reference from the charts, the author had done several groupings ensuring each factors related to the point discussed. All the charts are based on the information found from the collected data. The categories include the type of defects, type of roofs and types of material used for rectification works.

## 2. Data Analysis and Discussion

Table 1: Waterproofing product materials list- European based.



No	Logo	Company	HQ	Est.	Most applied product	4 seasons climate	Tropical all year	Sold
1		Axter	Paris, France	1922	Torch applied membrane; anti root with bituminous membrane.	Yes	Yes	World
2		Sika AG Group	Baar, Switzerland	1910	Epoxy coating (outdoor) and cementitious (indoor wet areas/for outdoor use to be rendered on top)	Yes	Yes	World
3		Fosroc Ltd.	London, UK and Dubai UAE	1940	Construction sealants and wet areas cementitious.	Yes	Yes	World
4		Soprema	Strasbourg, France	1908	Liquid membrane.	Yes	Yes	World
5		GE Sealants	Huntsville, NC, USA	1940	Construction sealants. Silicone sealants.	Yes	Yes	World







6		Bostik	Paris, France	1889	Sealants and adhesive.	Yes	Yes	World
7		Bitumat	Dammam, KSA	1975	Bitumen's torch membrane.	No	Yes	Mid-east, Africa, Asia, South America

The above (Table 1) is the list on among the waterproofing products found from the website search as well as the products being used in actual rectification works done by the specialist contractor in most of the project in Malaysia. It is interesting to note that all of these products originally being produced in Europe except Bitumat© which is from the Kingdom of Saudi Arabia. Even though most of the products above having its main plant in Europe and being exported to Asia however some products having its own plant locally in Malaysia; for example Sika© having its plant in Nilai, Negeri Sembilan to cater for the Malaysian market. It is interesting also to point out that these products has been used for the European market which having totally different weather pattern with the tropical hot and humid climate of Malaysia as Europe having from hot and dry Mediterranean to Continental extreme winter seasons. Marshall et al. wrote the importance of understanding how the building particularly a house being inspected was built, in general and in detail, and the products or materials used to do so, applies not only to older historic heritage buildings [2]. It is interesting to note that the Bostik© sealant and adhesive product was first established in Europe as early as in 1889 the same year Eiffel Tower was finished constructed by France engineer architect Alexandre Gustave Eiffel.

Furthermore, below [next page] (Table 2) is the list of the selected waterproofing products which are being offer in the Malaysian market today. Other than the products being imported from Europe, Saudi Arabia or even Australia; the Malaysian based waterproofing products has been used regularly for the local projects. Even though the local products has been competing with the imported products, the quality standard of the products are at par with the European products with having the Malaysian quality standard monitoring label on them. It is interesting to note that some products having its parent company outside Malaysia i.e. Singapore and South Korea but having its main distribution offices in Malaysia to cater the local market.

Table 2: Waterproofing selected products list: Use in Malaysia.

No	Logo	Company	HQ	Est.	Most applied product	4 seasons climate	Tropical all year	Sold
1		Bina Paint Marketing Sdn Bhd	Selangor, Malaysia	1992	Elastomeric waterproofing coating.	No	Yes	Malaysia only
2		PLC Laboratory Sdn Bhd	Selangor, Malaysia	1995	Roof coatings. Epoxy and p.u. grout. Acrylic elastomeric coating.	No	Yes	Malaysia only

3		Atlas Industry Sdn Bhd (under Taiko Group)	Selangor, Malaysia	1968	Coating primer. Modified bituminous compound emulsions. Synthetics resin.	No	Yes	Malaysia only
4		Axel Chemie Sdn Bhd	Kuala Lumpur,	1986	Roof coating for metal, clay and concrete flat roof.	No	Yes	Malaysia only
5		Polycell Sdn Bhd (under TYGA Corp.)	Selangor, Malaysia	1980	Foam grout.	No	Yes	Malaysia only
6		Quicseal Pte Ltd	Singapore	1988	Liquid applied waterproofing system. Silicone sealant.	Yes	Yes	Malaysia China Philippine South Korea
7		ESTOP Sdn Bhd	Shah Alam, Selangor, Malaysia	1990	Waterproofing system, coating, water stop, joint filler, sealants, concrete repair and grout.	Yes	Yes	Malaysia China South Korea Indonesia Singapore Hong Kong
8		Shell Malaysia	Kuala Lumpur, Malaysia	1964	Shell Flintkote is for internal wet areas waterproofing system as well as for flat concrete roof and metal roof.	No	Yes	Malaysia only

There is no research so far has been done to prove that the local waterproofing products perform much better compare to the imported one which may ideally being formulated for the harsh cold climate of the European

continent. It is understandable to feel that the local Malaysian waterproofing product may be more suitable to be applied for the hot and humid tropical Malaysian weather. For record, all the above local products has been used for the real rectification works in Kuala Lumpur, Melaka Ipoh and Pulau Pinang with projects ranging from schools, office buildings, hospitals and university buildings with minimum 10-15 years warranty being given to the building's owner.

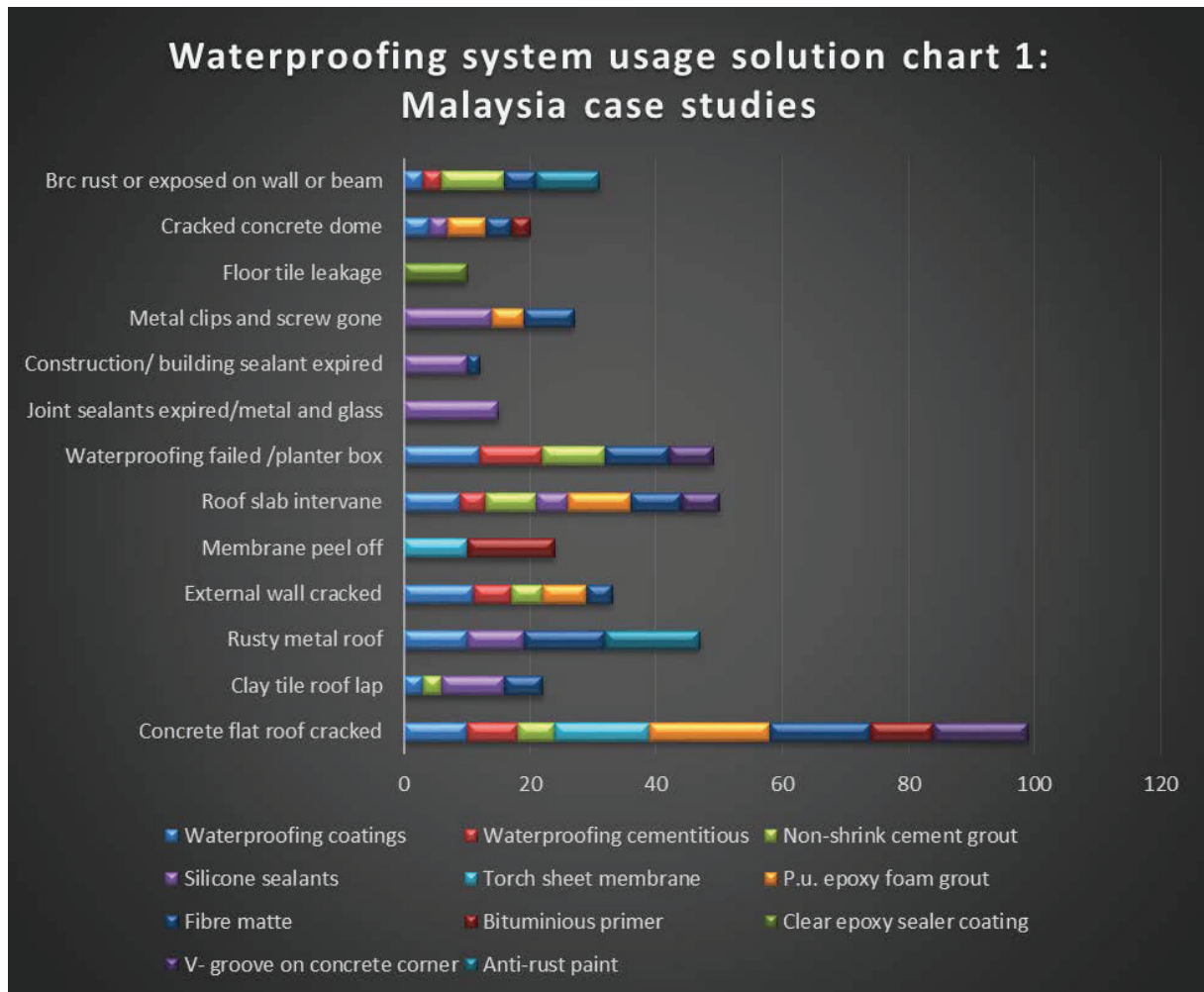


Figure 1: Waterproofing system usage solution chart 1: Malaysian case studies.

The graph above (Fig. 1.) provide the information on the various waterproofing products being used for specific tasks or on specific waterproofing failure for the typical selected Malaysian case studies. This list shows 13 typical problems building manager facing for the building leakage syndrome scenario to be solved. However, the graph helps by giving the best possible products can be used to solve that specific problem. It seems like most of the products can be used to solve concrete flat roof seepage cracked. For example, p.u. epoxy foam grout is the best short term solution for the cracked concrete slab by injecting the epoxy using high pressure grouting machine into the concrete through the packer head where usually Tyga© product has been used for this task. According to Addleson, the rectification works must be done based on the actual analysis with accurate diagnosis of the cause of the defect as is reasonably possible. Unless this is done, the remedial work may not only turn out to be quite inappropriate or short-lived but may also lead to other defects [3].



Please note that the longer the bar of the graph; the higher possible usage of the product can be used for that particular task. This evaluation derived from the experience and from the practical knowledge of using the products done to solve the leakage problem from the actual works done. It is hope the list can also be used as a guide for the practitioners to start determine on the selection of the waterproofing products best possible usage for a specific leakage task.

It is interesting to note that the range of the waterproofing products can be selected from the local products as well as from imported products especially from Europe with no indication on local weather effect regardless the location.

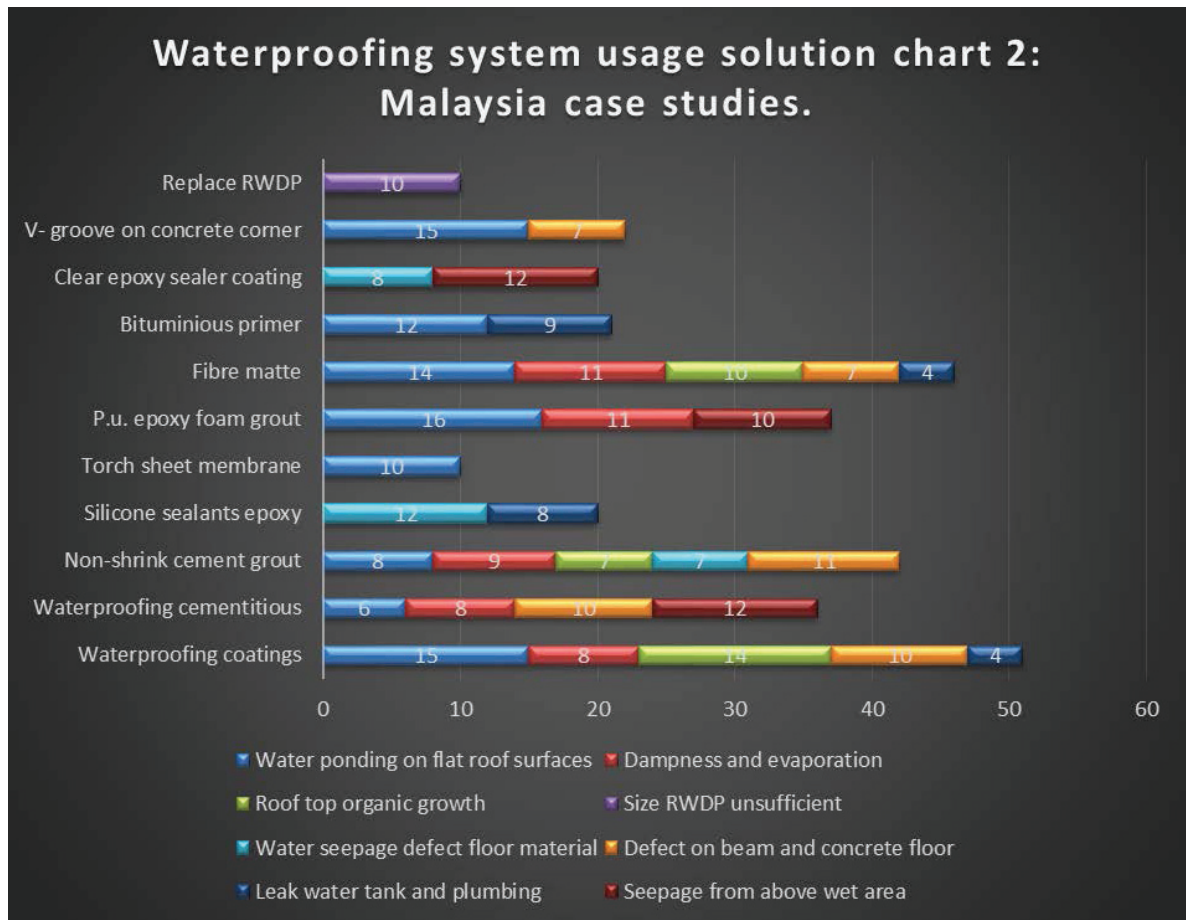


Figure 2: Waterproofing system usage solution chart 2: Malaysian case studies.

Graph number 2 (Fig. 2.) above list up 9 waterproofing materials and 2 waterproofing solver methods in Malaysia with 8 different type of roofing problem defects for reference. The case studies are taken from the actual projects done by the waterproofing specialist contractor with buildings ranging from commercial buildings, Government offices, academic buildings and housing as well as some buildings categorized as heritage historical buildings. The graph shows the coating epoxy is the most frequent waterproofing material being used for most of the roofing defects cases. 5 out of 8 defect cases seem make use of coating to solve its problem. According to Stringer if a fully planned and integrated maintenance programmed is being considered, some form of inspection of the internal construction, finishes and fitting of a building must be included [4].

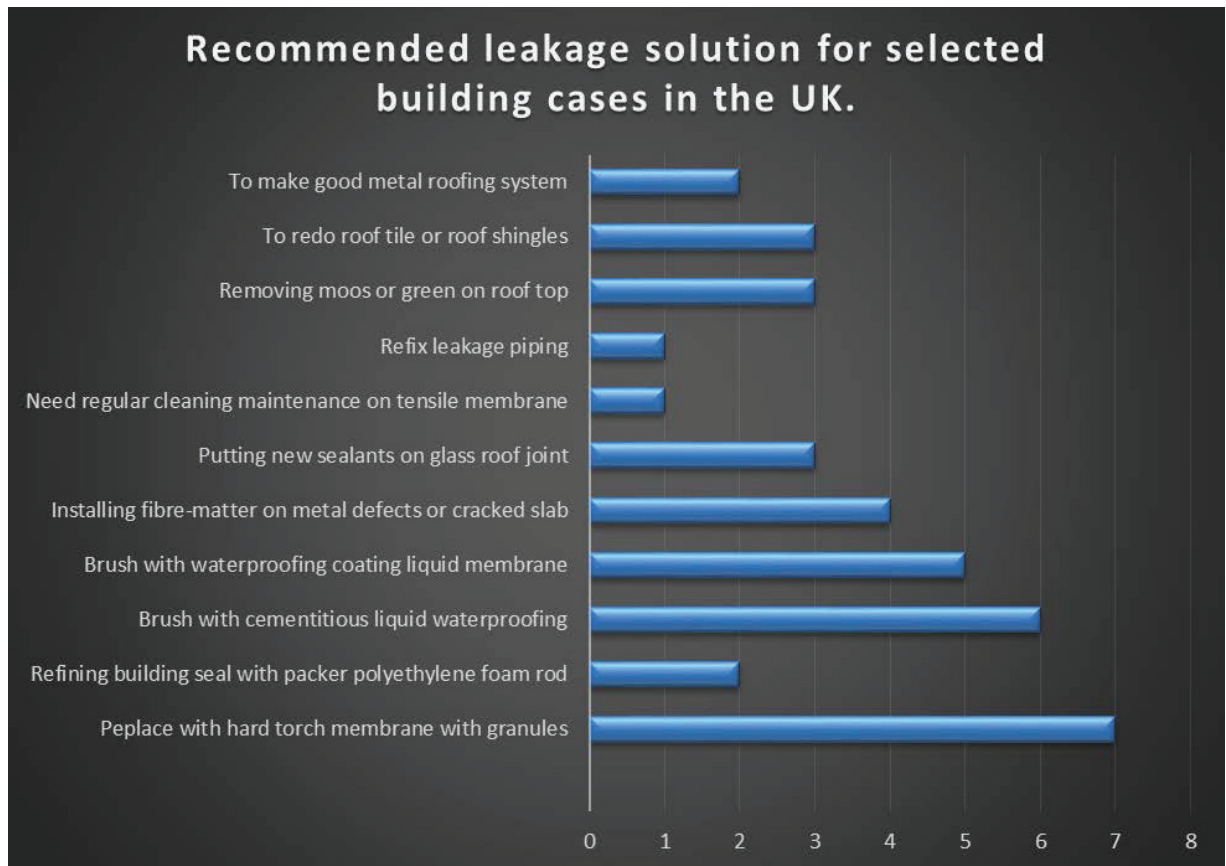


Figure 3: Recommended leakage solution for selected building cases in the UK.

It is interesting to note that fiber matte material is the second most used to fix the leakage problem. The matte normally used to patch-up the leak point or line on the concrete or metal and brush with epoxy coating on top of it to seal the leakage. It seem the fiber matte being used much more regularly for the water ponding cases on flat concrete roofing.

The next waterproofing material regularly being used for the leakage problem is non-shrink cement grout which is a type of cement with high strength and nor simply permit water. It is being used normally at the corner joint between the floor and wall with render at 45° as the corner joint normally happen the regular cracks and permit leakage. Kamal and Harun indicate that defects can be repaired satisfactorily only if the causes have been correctly diagnosed. Experience has shown that errors are sometimes made, because it is not possible to obtain all the relevant information, but more often because the symptoms have not fully investigated or the information has not been correctly interpreted [5].

The chart below (Fig. 3) shows the recommended leakage solution for selected buildings including heritage building cases in the UK to compare it with the Malaysia case studies. From the author personal observation, most of the buildings in the UK which having concrete flat roofing where most of it need to replace its old roof membrane with hard torch membrane (with granules). This case is shown from the leakage solution graph above where the membrane with granules is on top list in the UK as far as in identifying leakage solution for most buildings as case study in this research. The second most use waterproofing material used to solve the roof leakage problem for UK scenario is by using cementitious liquid normally being applied on top of concrete flat roof as well as on top of zinc or metal roof. Stringer as in Scottish Maintenance Practice Manual mentioned that not only is there an individual authority requirement to ensure that the experience of the maintenance department is fed back to and acted upon by the design department but there is also a general requirement that the consolidated experience of maintenance



departments throughout the country be made more widely known to all those working on similar forms of construction [6].

It is hoped that this list can be able at least to help those involved in the construction industry whether in the Malaysian task as well as in the UK identifying his or her leakage cases and be able to use it properly using appropriate waterproofing material as identified in the charts.

### 3. Conclusion and Issues

There are not much differences in term of typical causes that leading to building leakage both for the Malaysia cases and the UK cases scenario. Even though both countries enjoying two different types of climate; however the product used for the project cases are about the same using universal products. Anyway, it is very important to the contractor to ensure the quotation mentioned to use correct waterproofing system to be applied for the right leakage job. For the building owner's maintenance team; they also must at least to ensure that knowledge on waterproofing materials with possible leakage solution be at sound situation just to ensure all the contractor proposal to best suit the problem. Most of the contractors work usually come with at least 10 to 15 years warranty thus the rectification works done by the contractor must be at its best performance and using the best possible solution so that no rectification work to be after the initial rectification work done. Thus, this paper is derived based on the contractor experience in handling actual waterproofing works and the findings from the paper is based on the actual works is an asset for the maintenance manager use a framework in solving the waterproofing problem. According to Ford, building construction is not just in the sense of the building; not just as a practical necessity, but in the way that we see it, the way we understand it as a manifestation of science, as an object to which we intuitively respond, as part in a history that we know [7]. Thus the art of doing the rectification work from all the 3 graphs be able to signal the maintenance crew as well as the design team from its architectural details to waterproofing material identification as a framework in order to solve the building defects matters. McMorrough indicated that the art of architectural detail is not easily quantified or defined. It is certainly more than the sum of the system and materials that give it shape, though architecture would not exist without the standardized procedures that erect its forms [8].

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